

Response

Applicant: Hong-Jyh Li

Serial No.: 10/816,503

Filed: April 1, 2004

Docket No.: 2004P51130US/1331.128.101

Title: PLASMA ION IMPLANTATION SYSTEM

REMARKS

The following remarks are made in response to the Non-Final Office Action mailed January 12, 2007. Claims 1-31 were rejected. Claims 1-31 remain pending in the application and are presented for reconsideration and allowance.

Claim Rejections under 35 U.S.C. § 103

The Examiner rejected claims 1-31 under 35 U.S.C. § 103(a) as being unpatentable over Collins et al., U.S. Patent No. 6,518,195 ("Collins") in view of Jeon, U.S. Patent No. 6,790,755 ("Jeon").

Applicant submits that Collins and Jeon, either alone, or in combination, fail to teach or suggest the invention recited by independent claim 1 including **a voltage source configured to provide a bias voltage between the sample holder and the vacuum chamber to attract ions to implant in a high-k dielectric layer of a sample positioned on the sample holder.**

Collins discloses a domed plasma reactor chamber that uses an antenna driven by RF energy that is inductively coupled inside the reactor dome. The antenna generates a high density, low energy plasma inside the chamber for etching metals, dielectrics, and semiconductor materials. (Abstract). Collins discloses specific process aspects including etching oxide; "light" etching of silicon oxide and polysilicon; high rate isotropic and anisotropic oxide etching; etching polysilicon conductors; photoresist stripping; anisotropic etching of single crystal silicon; anisotropic photoresist etching; low pressure plasma deposition of nitride and oxynitride; high pressure isotropic conformal deposition of oxide, oxynitride, and nitride; etching metals; and sputter facet deposition, locally and globally, and with planarization. (Col. 6, lines 5-17).

Jeon discloses a layered dielectric structure comprising an alternating pattern of at least two sub-layers of a first dielectric material which is a high-K dielectric material and at least one layer of a second dielectric material which is a standard-K dielectric material, wherein at least one of the one or more second dielectric material sub-layers contain nitrogen implanted therein using a nitridation step. (Abstract).

The Examiner admits that Collins fails to disclose implanting ions into a high-k dielectric layer. (Office Action, page 4). Both Collins and Jeon fail to teach or suggest a voltage source configured to provide a bias voltage between the sample holder and the

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vacuum chamber *to attract ions to implant in a high-k dielectric layer* of a sample positioned on the sample holder. Collins fails to disclose an *ion implantation system*. In contrast, Collins discloses a system for depositing or etching materials. The system of Collins cannot be used to perform ion implantation. Jeon also fails to disclose an ion implantation system.

In addition, there is no teaching or suggestion to combine Collins and Jeon to arrive at the invention recited by independent claim 1. Collins is a deposition and etching system. One skilled in the art would not use a deposition and etching system to implant ions into a high-k dielectric layer. In fact, the system of Collins cannot be used to implant ions into a high-k dielectric layer. Therefore, one skilled in the art could not combine Collins and Jeon and arrive at the invention recited by independent claim 1.

In view of the above, Applicant submits that the above rejection of independent claim 1 under 35 U.S.C. § 103(a) should be withdrawn. Dependent claims 2-7 further define patentably distinct independent claim 1. Accordingly, Applicant believes these dependent claims are also allowable over the cited references. Allowance of claims 1-7 is respectfully requested.

Further, Collins and Jeon, either alone, or in combination, fail to teach or suggest **wherein the ions comprise one of F, Si, O, Hf, Zr, Ti, Ta, Y, V, Sc, Ba, Sr, Ru, B, Al, Ga, In, Ge, C, P, As, and Sb** as recited by dependent claim 3. The Examiner took official notice that it is well known in the art to implant ions selected from the listed group and cited Yamada et al., U.S. Patent Application Publication No. 2001/0054746 ("Yamada") as support. (Office Action, page 4). Yamada, however, fails to teach or suggest this claim limitation. In addition, as indicated in the Manual of Patent Examining Procedure, "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." MPEP § 2144.03(A). "It would not be appropriate for the examiner to take official notice of facts without citing a prior art reference where the facts asserted to be well known are not capable of instant and unquestionable demonstration as being well-known." *Id.* (emphasis in original). Applicant contends that the limitations of claim 3 that the Examiner indicated were not disclosed by Collins or Jeon are not well known facts that are capable of instant and unquestionable demonstration as being well known. Applicant respectfully requests allowance of this claim,

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or requests pursuant to M.P.E.P. § 2144.03 that the Examiner cite a reference to teach the further limitations of claim 3.

For the same reasons as discussed above with reference to claim 1, Collins and Jeon, either alone, or in combination, also fail to teach or suggest the invention recited by independent claim 8 including **a constant DC voltage source configured to accelerate positive ions toward a high-k dielectric layer of the sample to implant the positive ions in the high-k dielectric layer and to repel negative ions from the sample.**

In view of the above, Applicant submits that the above rejection of independent claim 8 under 35 U.S.C. § 103(a) should be withdrawn. Dependent claims 9-15 further define patentably distinct independent claim 8. Accordingly, Applicant believes these dependent claims are also allowable over the cited references. Allowance of claims 8-15 is respectfully requested.

Further, for the same reasons as discussed above with reference to claim 3, Collins and Jeon, either alone, or in combination, fail to teach or suggest **wherein the positive ions comprise one of F, Si, O, Hf, Zr, Ti, Ta, Y, V, Sc, Ba, Sr, Ru, B, Al, Ga, In, Ge, C, P, As, and Sb** as recited by dependent claim 11. Applicant contends that the limitations of claim 11 that the Examiner indicated were not disclosed by Collins or Jeon are not well known facts that are capable of instant and unquestionable demonstration as being well known. Applicant respectfully requests allowance of this claim, or requests pursuant to M.P.E.P. § 2144.03 that the Examiner cite a reference to teach the further limitations of claim 11.

In addition, Collins and Jeon, either alone, or in combination, fail to teach or suggest **wherein the sample comprises a buffer layer proximate the high-k dielectric layer** as recited by dependent claim 13, **wherein the DC voltage source is configured to accelerate positive ions toward the buffer layer of the sample to implant the positive ions in the buffer layer** as recited by dependent claim 14, and **wherein the buffer layer comprises one of TiN, HfN, TaN, ZrN, LaN, SiN, and TiSi** as recited by dependent claim 15. The Examiner took official notice that these limitations are well known in the semiconductor process art and cited Yamada as support. (Office Action, pages 5-6). Yamada, however, fails to teach or suggest these claim limitations. Applicant contends that the limitations of claims 13-15 that the Examiner indicated were not disclosed by Collins or Jeon are not well known facts that are capable of instant and unquestionable demonstration as being well

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known. Applicant respectfully requests allowance of these claims, or requests pursuant to M.P.E.P. § 2144.03 that the Examiner cite a reference to teach the further limitations of claims 13-15.

For the same reasons as discussed above with reference to claims 1 and 3, Collins and Jeon, either alone, or in combination, also fail to teach or suggest the invention recited by independent claim 16 including **the ions comprising one of F, Si, O, Hf, Zr, Ti, Ta, Y, V, Sc, Ba, Sr, Ru, B, Al, Ga, In, Ge, C, P, As, and Sb; and a voltage source configured to accelerate positive ions toward a first high-k dielectric layer of the sample to implant the positive ions in the first high-k dielectric layer and to repel negative ions from the sample.**

In view of the above, Applicant submits that the above rejection of independent claim 16 under 35 U.S.C. § 103(a) should be withdrawn. Dependent claims 17-24 further define patentably distinct independent claim 16. Accordingly, Applicant believes these dependent claims are also allowable over the cited references. Allowance of claims 16-24 is respectfully requested.

Further, for the same reasons as discussed above with reference to claims 13-15, Collins and Jeon, either alone, or in combination, fail to teach or suggest **wherein the voltage source is configured to accelerate positive ions toward a buffer layer of the sample adjacent the second high-k dielectric layer to implant the positive ions in the buffer layer** as recited by dependent claim 20, **wherein the buffer layer comprises at least one of TiN, HfN, TaN, ZrN, LaN, SiN, and TiSi** as recited by dependent claim 21, and **wherein the buffer layer comprises a stack of layers** as recited by dependent claim 22. Applicant contends that the limitations of claims 20-22 that the Examiner indicated were not disclosed by Collins or Jeon are not well known facts that are capable of instant and unquestionable demonstration as being well known. Applicant respectfully requests allowance of these claims, or requests pursuant to M.P.E.P. § 2144.03 that the Examiner cite a reference to teach the further limitations of claims 20-22.

For the same reasons as discussed above with reference to claim 1, Collins and Jeon, either alone, or in combination, also fail to teach or suggest the invention recited by independent claim 25 including **accelerating positive ions in the plasma toward the**

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sample to implant the positive ions in the high-k dielectric layer while repelling negative ions from the sample.

In view of the above, Applicant submits that the above rejection of independent claim 25 under 35 U.S.C. § 103(a) should be withdrawn. Dependent claims 26-31 further define patentably distinct independent claim 25. Accordingly, Applicant believes these dependent claims are also allowable over the cited references. Allowance of claims 25-31 is respectfully requested.

Further, for the same reasons as discussed above with reference to claim 3, Collins and Jeon, either alone, or in combination, fail to teach or suggest **wherein generating a plasma comprises generating a plasma comprising one of F, Si, O, Hf, Zr, Ti, Ta, Y, V, Sc, Ba, Sr, Ru, B, Al, Ga, In, Ge, C, P, As, and Sb ions** as recited by dependent claim 27. Applicant contends that the limitations of claim 27 that the Examiner indicated were not disclosed by Collins or Jeon are not well known facts that are capable of instant and unquestionable demonstration as being well known. Applicant respectfully requests allowance of this claim, or requests pursuant to M.P.E.P. § 2144.03 that the Examiner cite a reference to teach the further limitations of claim 27.

In addition, Collins and Jeon, either alone, or in combination, fail to teach or suggest **wherein accelerating positive ions in the plasma toward the sample to implant the positive ions in the sample comprises implanting the positive ions having a dose greater than 1×10^{13} ions/cm² and less than 1×10^{16} ions/cm² as recited by dependent claim 30 and wherein accelerating positive ions in the plasma toward the sample to implant the positive ions in the sample comprises accelerating the positive ions to have an implant energy greater than 5eV and less than 10keV as recited by dependent claim 31.** The Examiner took official notice that these limitations are well known in the semiconductor process art and cited Wu, U.S. Patent No. 6,130,135 ("Wu") as support. (Office Action, pages 6-7). Wu, however, fails to teach or suggest these claim limitations. Applicant contends that the limitations of claims 30 and 31 that the Examiner indicated were not disclosed by Collins or Jeon are not well known facts that are capable of instant and unquestionable demonstration as being well known. Applicant respectfully requests allowance of these claims, or requests pursuant to M.P.E.P. § 2144.03 that the Examiner cite a reference to teach the further limitations of claims 30 and 31.

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CONCLUSION

In view of the above, Applicant respectfully submits that pending claims 1-31 are in form for allowance and are not taught or suggested by the cited references. Therefore, reconsideration and withdrawal of the rejections and allowance of claims 1-31 is respectfully requested.

No fees are required under 37 C.F.R. 1.16(b)(c). However, if such fees are required, the Patent Office is hereby authorized to charge Deposit Account No. 50-0471.

The Examiner is invited to contact the Applicant's representative at the below-listed telephone numbers to facilitate prosecution of this application.

Any inquiry regarding this Amendment and Response should be directed to Steven E. Dicke at Telephone No. (612) 573-2002, Facsimile No. (612) 573-2005. In addition, all correspondence should continue to be directed to the following address:

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Respectfully submitted,

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Date: March 16, 2007

SED:kmh

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